

# The domino effect for markets

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**Abstract:** A generalization of the Cont-Bouchaud market model to three markets agrees with the correlations between New York, Tokyo, and Frankfurt observed by Vandewalle et al.

**Keywords:** Econophysics, percolation model, Monte Carlo simulations, linear coupling.

As studied by Vandewalle et al [1], different stock markets like Tokyo, Frankfurt and New York are not independent of each other. We try to reproduce this observation in the well-known Cont-Bouchaud [2, 3] percolation model. We will find that indeed in about 32 % of the cases all three markets have the same sign of change, as seen in reality [1].

The Cont-Bouchaud model[2, 3] treats each percolation cluster as a company of individuals, who either all buy together (with probability  $a_{buy}$ ), or all sell together (with probability  $1 - a_{sell}$ ), or all do not act (with probability  $1 - a_{buy} - a_{sell}$ ). For  $a_{sell} = a_{buy}$  the market goes up or down with equal probability since supply and demand agree on average. Thus if then three markets are simulated together, in 1/8 of the cases one has all three of them going up, in another 1/8 all of them go down, and in the remaining 3/4 of cases the results are mixed. In reality, however, in 17 % of the trading days, Tokyo, Frankfurt and New York went up together, in another 17 % they went

down together, and in only 66 % the results were mixed. Obviously, the results of the three markets influence each other, facilitated by the rotation of the Earth.

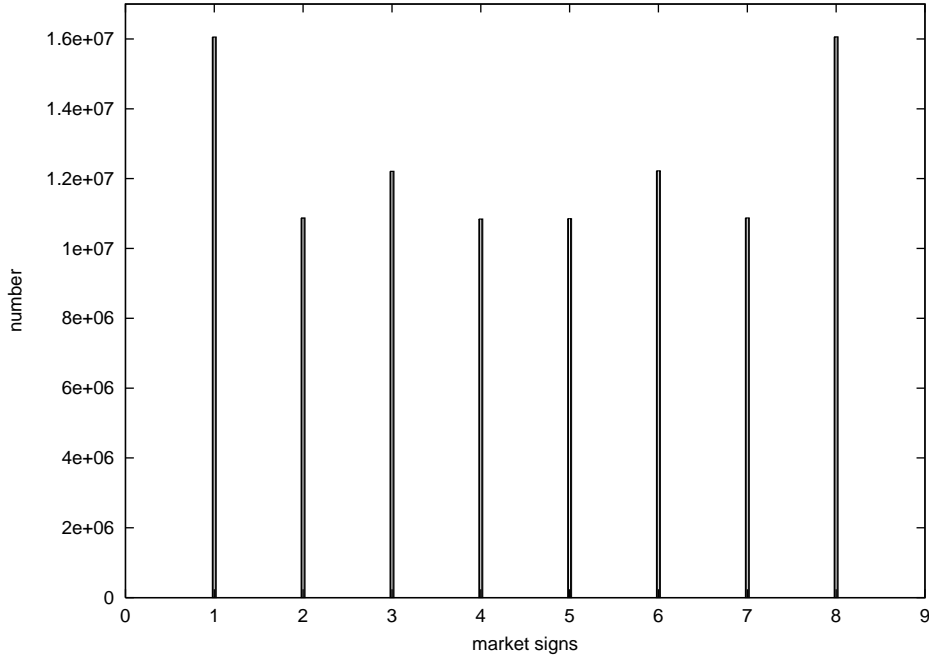


Figure 1: Histogram from 100,000 simulations with 1000 iterations each to have one of the eight possible combinations  $S_1 S_2 S_3$  of signs  $S_i = \text{sign}(r_i)$ , with  $---, --+, -+-, \dots, +++$  from left to right. Very similar results were published for reality [1].

We thus assume

$$a_{buy,i} = 0.05(1 + \sum_k c_{k,i} r_k); \quad a_{sell,i} = 0.05(1 - \sum_k c_{k,i} r_k)$$

with  $k = i$  omitted: 1 = New York, 2 = Tokyo, 3 = Frankfurt. Here  $c_{i,k}$  gives the influence of market  $i$  on market  $k$ , and the return  $r_i$  is the relative price change of the market (Dow Jones Industrials, Nikkei, Dax) of the preceding day. We take  $c_{i,k} = 0$  except for  $c_{1,2} = 0.001$ ,  $c_{1,3} = 0.002$ ,  $c_{2,3} = 0.0005$  for a  $101 \times 101$  Ising lattice at  $T/T_c = 1.1$  as in [4]. The figure shows a probability of about 32 % for all three  $r_i$  to have the same sign  $S_i = \text{sign}(r_i)$ . For uncorrelated markets this probability would only be 1/4, while in reality it

is 34 %. Taking appreciably different coupling coefficients  $c_{ik}$  gives different results, deviating from reality.

In conclusion, we found excellent agreement but do not exclude that the same agreement would also be found from other market models.

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